



**CALFED
BAY-DELTA
PROGRAM**

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P. Joseph Grindstaff,
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State Agencies

The Resources Agency:
Department of Water Resources
Department of Fish and Game
Delta Protection Commission
Department of Conservation
San Francisco Bay Conservation and
Development Commission
California State Parks
The Reclamation Board
California Environmental
Protection Agency:
State Water Resources Control Board
California Department of Food
and Agriculture
California Department
of Health Services

Federal Agencies

Department of the Interior:
Bureau of Reclamation
Fish and Wildlife Service
Geological Survey
Bureau of Land Management
US Army Corps of Engineers
Environmental Protection Agency
Department of Agriculture:
Natural Resources Conservation Service
Department of Commerce:
National Marine Fisheries Service
Western Area Power Administration

Date: September 14, 2007

To: John Kirlin, Executive Director
Delta Vision Blue Ribbon Task Force

From: Mike Healey
CALFED Lead Scientist

Subject: Draft DRMS Phase 1 Report Independent Review

At the request of the Department of Water Resources (DWR), the Science Program, working with the Independent Science Board (ISB), assembled a panel of independent experts to review the draft DRMS Phase 1 Report (Phase 1 Report). The Independent Review Panel (IRP) was chaired by former Lead Scientist, Johnnie Moore, of University of Montana and included Rich Adams, Ph.D., Oregon State University; Bob Gilbert, Ph.D., University of Texas; Katharine Hayhoe, Ph.D., Texas Tech University & ATMOS Research & Consulting; W.F. Marcuson III, Ph.D., P.E., American Society of Civil Engineers; Arthur Mynett, Sc.D., Delft Hydraulics; Deb Niemeier, Ph.D., P.E., University of California, Davis; Kenny Rose, Ph.D., Louisiana State University; and Roy Shlemon, Ph.D., Roy J. Shlemon, and Associates, Inc. This is a highly qualified panel to review the DRMS analysis. The panel received the Phase 1 Report on June 29, 2007, met in Sacramento, CA for discussion on August 2-3, 2007, and submitted its review to the Science Program on August 23, 2007. Because of delays in preparation of the Phase 1 Report, the IRP worked on a very short time line to produce a thorough and insightful review of the document.

The IRP was highly critical of the Phase 1 Report finding serious methodological difficulties in several areas. The most serious general concerns of the IRP were labeled Tier 1. For your information, I have attached the review summary and Tier 1 issues as provided by the IRP. The IRP also had many more specific technical criticisms labeled Tier 2. I have not attached these as they are highly technical but some of them also speak to important methodological problems with the Phase 1 Report.

The ISB was briefed on the IRP review at its August 28, 2007, meeting by Johnnie Moore and expressed concern about apparent methodological problems and lack of transparency in the Phase 1 Report. The IRP review has been forwarded to DWR. Joe Grindstaff and I met with representatives of DWR and their consultants to decide how the concerns of the IRP should be addressed. It was agreed that DWR and its consultants would prepare a response detailing how they would address the concerns of the IRP and work with the IRP to ensure that the final Phase 1 Report is transparent and provides as quantitatively accurate

assessment of risks as possible. The DRMS consultants have prepared a response to the IRP concerns, accepting that there are problems with the report and analyses that need to be addressed (except for the analysis of seismic risk, where the IRP appeared not to have understood the analysis). DWR and the DRMS consultants have conferred with the IRP in conference call and there is general agreement as to how the Phase 1 analysis and report should be revised. The DRMS consultants will also participate in a conference call with the ISB September 25th to discuss the DRMS response to the IRP review. The DRMS consultants are proceeding with revisions and new analyses, however, it will probably be at least November or December before a revised report can be completed, perhaps not even then. The required changes are substantial and will take time.

Until such time as the Phase 1 Report is revised and the substantive concerns of the IRP are addressed, I caution the Task Force to use the conclusions of the report and any analyses that depend on Phase 1 (e.g., the draft Phase 2 report and building block “flash cards” as presented to the Task Force) with caution. The conclusions of Phase 1, that the risk of levee failure due to a seismic event is high and that the costs of levee upgrading will be very high are consistent with other analyses and are probably true, but the quantitative estimates of risk and cost cannot be depended on at this stage.

Sincerely,

A handwritten signature in black ink, appearing to read 'Mike Healey', with a long horizontal stroke extending to the right.

Mike Healey
CALFED Lead Scientist

Attachment

cc: Les Harder, DWR
Ralph Svetich, DWR

Review of the Delta Risk Management Strategy Report, Phase 1

URS Corporation/Jack R. Benjamin & Associates, Inc., June 26, 2007

CALFED Science Program Independent Review Panel

Rich Adams, Ph.D., Oregon State University, Corvallis, OR

Bob Gilbert, Ph.D., University of Texas, Austin, TX

*Katharine Hayhoe, Ph.D., Texas Tech University & ATMOS Research & Consulting,
Lubbock, TX*

W.F. Marcuson III, Ph.D., P.E., Marcuson III and Associates, Inc.

Johnnie Moore, Ph.D., University of Montana, Missoula, MT

Arthur Mynett, Sc.D., Delft Hydraulics, UNESCO-IHE Delft, The Netherlands

Deb Niemeier, Ph.D., P.E., University of California, Davis, CA

Kenny Rose, Ph.D., Louisiana State University, Baton Rouge, LA

Roy Shlemon, Ph.D., Roy J. Shlemon, and Associates, Inc., Newport Beach, CA

August 23, 2007

Review Summary

The *Delta Risk Management Strategy study* (DRMS), which comprises two phases, will underpin policy decisions regarding future infrastructure investments and water resource management in the San Joaquin-Sacramento Delta region for decades to come. *Phase I* results must establish a robust scientific and engineering foundation. This is essential for completing *Phase II*, the identification, and prioritization of strategies for reducing risk in the Delta. In short, *Phase I* is a vital first step in assuring the future sustainability and productivity of the Delta region.

The Independent Review Panel (Panel) found many technical problems in each section of the *Phase I Report*. Several of these emerged as major concerns because they may greatly influence the results and conclusions presented in the report. The major concerns which the Panels terms Tier 1, were: (1) lack of documentation and transparency of analyses, (2) limited actual analyses carried through to the end, (3) limited treatment of uncertainty, (4) lack of integration of single component analyses to produce the final results, and (5) lack of a clear, robust methodology for assessing impacts on aquatic resources. Other important technical concerns (Tier 2) were related to specific analyses in each section. The Panel believes the impact of these issues on the final analyses may be moderate to minor in nature.

For many components of the report, the general approach of the DRMS analysis is well done and consistent with standard practice. However, for other components, the science must be strengthened and most importantly, the implementation (coupling of the components and their models) must be fully transparent, which can only result from improved documentation and completeness to the analyses. As written, many of the analyses are generally incomplete and therefore inadequate to serve as a foundation from which to make reasonable policy decisions about future resource allocations concerning strategies for the Delta region. In other words, the Panel believes strongly that the inadequacies in some of the analyses may lead policymakers and others to erroneous conclusions and inappropriate decisions.

Tier 1 Issues

Lack of Transparency of Analyses

The report is poorly written, lacks transparent documentation of methods, including assumptions (and departures from assumptions), is unbalanced in terms of treatment of hazards and lacks consistency in how the risk analyses are performed. Probability, frequency, rate, likelihood, and even risk are used interchangeably and not consistently or clearly defined. It was difficult for the Panel, who are well versed in these topics and models, to piece together exactly what was done. One very important aspect of good scientific and engineering practice is clear and understandable documentation of assumptions, methods, results, interpretations, and conclusions. Indeed, the report is inconsistent to the point that what was described as having been done in the beginning sections does not match what was done in later sections. A few of the sections are better documented, especially when coupled with their associated technical memoranda (e.g., seismic and flooding), but most, including the critical sections that integrate the various analyses, suffer greatly from inadequate documentation. There is little comparison of results to previous analyses, and some spot-checking by the members of the Panel suggested that aspects of some of these new results are significantly different from the results of similar previous analyses. In fact, the entire project seems not to have followed standard review practices. As it is written, this draft report fails the adequate documentation standard, which necessarily means it fails the test of providing adequate information for public decision-making.

Limited Actual Analyses Carried Through to the End

Beyond the poor documentation issues, the fundamental technical problem with the report is that many of the critical analyses are simply incomplete. That is, what is promised in early sections of the report (complete probabilistic assessment of risk) is not delivered. The probabilities and consequences are not integrated over the full range of possibilities, from high-frequency, small consequence events to low-frequency, large consequence events. Human health risks, in terms of probabilities and consequences, are not provided. Only 18 earthquake scenarios are assessed for economic and ecosystem consequences, and even fewer flooding scenarios are assessed and they all correspond to low-frequency, large magnitude events. There is little if any attempt to evaluate the sensitivity of the results to input parameters and to assumptions in the modeling. This product at present is a major departure from the plan, from what was described at public presentations by the DRMS team, and even from what is described in the report itself.

Furthermore, there is an apparently unbalanced treatment of seismic versus hydrologic events in the risk analysis. For hydrologic events, consequences are only assessed for two scenarios of flooding. Consequences for the most frequent types of hydrologic failures historically, where fewer than ten islands are flooded, are completely neglected. Consequences due to water-supply disruption in the case of flooding from hydrologic events, even though it has occurred historically in a high-tide event, are neglected. Conversely for seismic events,

consequences are assessed for eighteen cases of flooding, ranging from single to multiple-island failures. In addition, the estimated frequency for flooding from seismic events is much larger than what is supported based on available information. The return period for an earthquake causing at least one levee failure is estimated to be about ten years, while a single event of this type has not occurred in over 100 years of history. Even considering only the past 20 years of history in which the configuration of the levees has been more similar to that at present, the analysis predicts that there would have been two failures on average and only a 16-percent chance of observing what has actually been observed: no failures. This unbalanced treatment of risks provides a potentially biased result, especially when comparing between seismic and flooding effects in evaluating mitigation measures. It is a serious flaw in the analyses presented in the draft report, which would be best solved by completing the analyses the project team was initially going to undertake, which means simulating many additional and more representative scenarios or fully enumerating all the scenarios. It is critical to recognize that electing to limit the full range of scenarios considered is a subjective decision, and without clear documentation as to why the decision was made, damages the concept of applying a quantitative tool as a way of being more objective.

Limited Treatment of Uncertainty

The IRP found that the method proposed to treat uncertainty described in the assessment was not actually represented in the reported results. That is, the authors included uncertainty, which is admirable, but only in the originating analyses of seismic and flooding events. They then report this originating uncertainty as the *total* uncertainty, which implies much more confidence in results than is actually justified. For example, consider the climate change projections. In the *Climate Change Technical Memorandum*, the uncertainties in sea-level rise and temperature for the year 2100 are captured through a recommended set of ranges or probabilistic curves that should be used in the simulations. However, in the actual report these are simplified to single values for years 2050, and 2100. This creates a false and potentially dangerous sense of inevitability and certainty. It implies that this is what "will" happen in the future, when in fact what happens could be far worse or better based on the uncertainty.

Scientific and socio-economic uncertainty must be presented clearly and propagated through all analyses. The analyses performed actually show the sensitivity of results to uncertainty for a few selected parameters. Since this is not the uncertainty one would realistically expect in the entire analysis, the assumption that only a few parameters really influence uncertainty must be documented and empirically supported. Without a true uncertainty analyses or documentation of why only a few uncertainties actually matter, it is impossible for the Panel to be confident that the results are a reasonable presentation of the risks and uncertainties embedded in the system. At a minimum, the report text should reflect what has actually been done (as seen in the reported results), should clearly document and support procedures and critical assumptions, and should include simple numerical examples displaying the linkages throughout the empirical sections of the report showing how uncertainty is propagated.

Lack of Integration of Analyses

The Panel was unable to fully understand how the multiple models used to assess the risks were linked together and how robust the results are to assumptions made in linking them. In analyses that use multiple, linked models, the details of how information and computer files are transferred and maintained to ensure all analyses use consistent information is a major bookkeeping challenge. As such, it is important that the discussion is transparent in terms of how the pieces (models, assumptions, etc.) fit together, and how robust the subsequently estimated frequencies and consequences are. Documentation of the QA/QC procedures used with the modeling process should comprise a separate technical memorandum. More information should specifically be included with the consequences modeling, especially with the consequences to human health and safety and fisheries resources.

Lack of Robust Methodology for Assessing Impacts on Aquatic Resources

The Panel is concerned about the treatment of ecosystem consequences in the analysis. There is, again, a major disconnect between the introductory methodology description, both in the beginning of the report and the beginning of the ecosystem consequences section, and what ultimately seems to have been done. As currently structured, the ecosystem analysis is incomplete, difficult to interpret and potentially understates the ecosystem effects of the various hazards confronting the Delta. While the Panel was of the opinion that the simplified approach used for terrestrial taxa was reasonable, the simplified approach used for the fish was inadequate. A new “risk index” was introduced for assessing the risks to key fish species. No justification or rationale is provided for, what appears to be, a new method. The reader has no idea how the weights were determined, how the computed risk index behaves, and what levels of the index should flag concern. The Panel had no idea how to interpret the changes in the risk index under the few earthquake and flooding scenarios that were performed and the authors also seemed to have little idea on how to interpret their own risk index. While the Panel appreciates the complexity of performing such an analysis and the unsuccessful attempt to develop a quantitative metric, alternative approaches are available to provide information on this important category of effects. For example, the authors may wish to assemble an expert panel to evaluate a small set of scenarios, which encompass a wide range of outcomes. Something better than the risk index needs to be developed, evaluated, and implemented to understand potential ecosystem consequences.

Concluding Tier 1 Comments

Until the major issues presented above are substantively addressed and the analyses are completed as originally proposed, the results of the DRMS *Phase I Report* are of limited utility. The Panel seriously questions the usefulness of any Phase 2 analyses that relies on results reported in a Phase 1 draft report that is not significantly revised to address the Panel's Tier 1 comments. The Panel is also emphatic that simple responses to their major comments that do not involve changes to the analysis methods would be considered an inadequate response by the Panel. We understand the time pressures that have been placed on the DRMS analysis, but the results are too important and potentially too useful to be rushed to the point that the results are not trusted or that the generated results are unjustified. In reviewing the DRMS project team responses to previous comments on the *Phase I Report* and technical memoranda, there seemed to be an inconsistency in the way in which review comments were handled. Some comments appeared to be simply dismissed, despite raising valid concerns, while others received more thoughtful responses. In scanning the review comments, there seems to be a predisposition toward constraining the scope of the report to an inappropriate degree. The Panel raises this final issue so that authors of the draft report can address our major comments with thoughtfulness, and make the needed changes in the analysis to make the DRMS as useful as possible.